

Infant and Toddler STEM: Science, Technology, Engineering and Mathematics

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childcare quality & early learning

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Where we are going today

- Introduction to Early STEM
- Science
- Mathematics
- Engineering and Technology

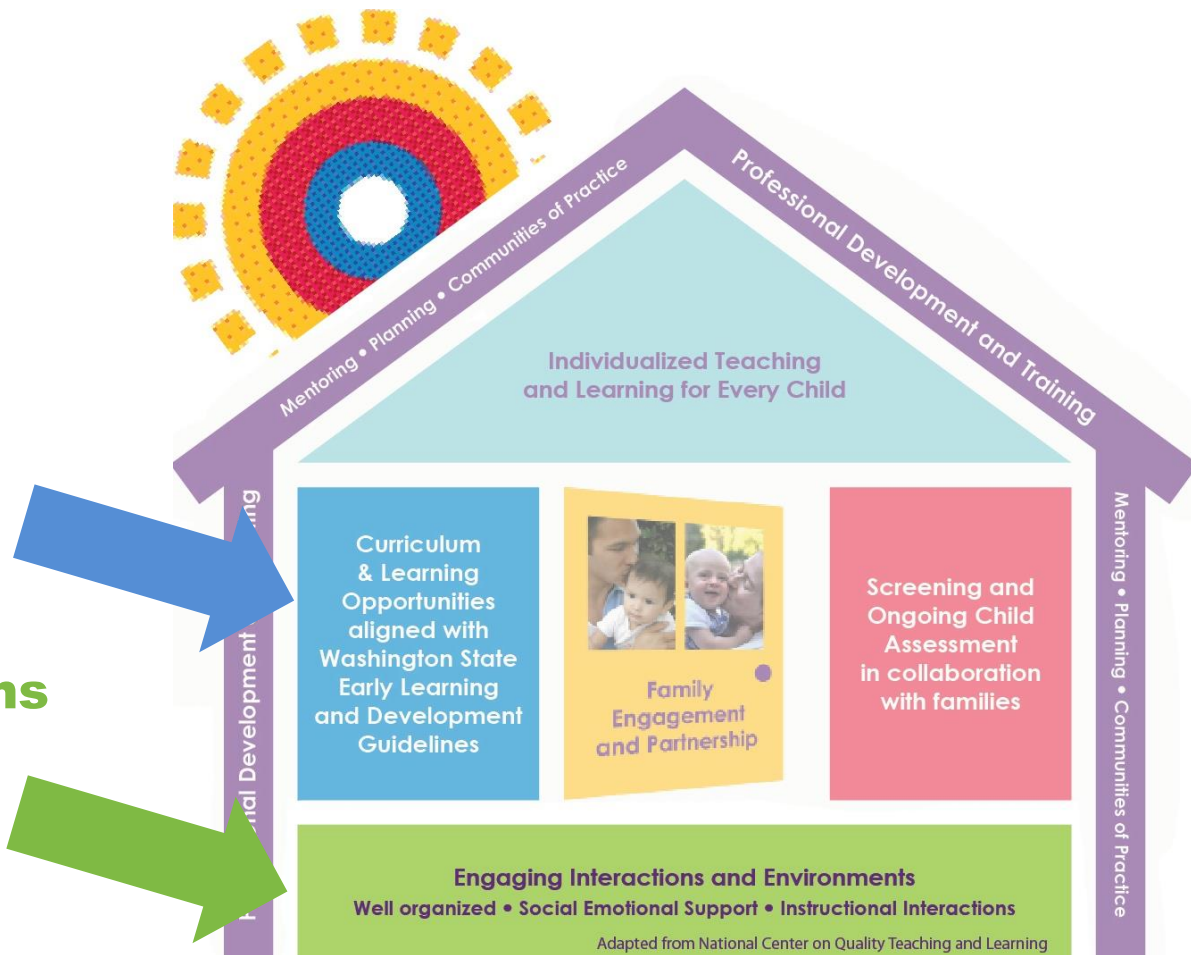


CONNECTIONS TO THE EARLY ACHIEVERS HOUSE

During this session, you will learn more about:

Curriculum and Learning Opportunities

Engaging Interactions and Environments



What is Early STEM All About?



BRAIN BUILDING FOR STEM

Science is a way of thinking. Science is observing and experimenting, making predictions, sharing discoveries, asking questions, and wondering how things work.

Technology is a way of doing. Technology is using tools, being inventive, identifying problems, and making things work.

Engineering is a way of doing. Engineering is solving problems, using a variety of materials, designing and creating, and building things that work.

Math is a way of measuring. Math is sequencing (1, 2, 3, 4...), patterning (1, 2, 1, 2, 1, 2...), and exploring shapes (triangle, square, circle), volume (holds more or less), and size (bigger, less than).

Science and Development



- Understanding the world around them is one of the strongest predictors of young children's later science learning and reading, and a significant predictor of mathematics

Grissmer et al., 2010

- Unfortunately, research suggest preschoolers have few opportunities to engage in science learning...
- And therefore learn few science skills and concepts before they enter school

Early et al. 2010; Greenfield, et al., 2009

How do Infants and Toddlers develop science skills and knowledge?

- Natural curiosity (such as intently watching an adult's expressions and actions)
- Readiness to repeat actions that have an interesting effect
- Need to explore and make sense of the world



Lagging behind in Science

TABLE 1
Fall and Spring Galileo Developmental Scores and Gains for 2002–2003
(*N* = 2,032) and 2003–2004 (*N* = 2,927) Head Start Years

<i>Variable</i>	<i>Year</i>	<i>Fall</i>	<i>Spring</i>	<i>Gain</i>
Approaches to Learning	2002–2003	483.3 (57.8)	594.6 (40.4)	111.3
	2003–2004	487.6 (65.8)	594.8 (42.6)	107.2
Creative Arts	2002–2003	491.4 (60.0)	602.5 (59.6)	111.1
	2003–2004	486.7 (62.5)	597.6 (61.9)	110.9
Early Math	2002–2003	464.8 (56.1)	565.2 (58.6)	100.4
	2003–2004	460.9 (55.7)	564.0 (62.7)	103.1
Language & Literacy	2002–2003	443.8 (66.5)	549.2 (56.8)	105.4
	2003–2004	450.9 (55.7)	546.6 (60.5)	96.7
Motor Development	2002–2003	495.9 (60.1)	601.9 (36.2)	106.0
	2003–2004	493.5 (66.7)	600.8 (37.1)	107.3
Science	2002–2003	444.9 (48.7)	528.3 (60.9)	83.4
	2003–2004	443.0 (42.7)	533.7 (62.2)	90.7
Physical Health	2002–2003	480.8 (55.7)	567.5 (39.9)	86.7
	2003–2004	473.4 (60.4)	565.7 (44.0)	92.3
Social & Emotional	2002–2003	440.0 (68.2)	544.4 (52.7)	104.4
	2003–2004	435.8 (69.4)	539.0 (56.5)	103.2

Why DO we need to start Science Early?

- Understanding the world around them is one of the strongest predictors of young children's later science learning and reading, and a significant predictor of mathematics

Grissmer et al., 2010

- Unfortunately, research suggest young children have few opportunities to engage in science learning... And therefore learn few science skills and concepts before they enter school

Early et al. 2010; Greenfield, et al., 2009

Every baby knows the
scientific method!



2 Form a hypothesis.

1 Make an observation.



3 Perform the experiment.

4 Analyze the data.



5 Report your findings.

6 Invite others to reproduce the results.



Science begins
with babies!

WHAT IS SCIENCE?

Inquiry Skills or
Science Practices



Knowledge:
Concepts or
Big Ideas

Vocabulary, Discourse and Language

What is the Scientific Method?



- Purpose: *What question are we trying to answer or discover?*
- Hypothesis: *What is an educated guess of the answer to our questions?*
- Materials: *What are the supplies or equipment we will need for our experiment?*
- Procedure: *How are we going to conduct our experiment? Step by Step?*
- Results: *What happen in our experiment?*
- Conclusion: *Was our hypothesis correct?*

How do Infants and Toddlers develop science skills and knowledge?

- Natural curiosity (such as intently watching an adult's expressions and actions)
- Readiness to repeat actions that have an interesting effect
- Need to explore and make sense of the world



How Adults support STEM for Infants and Toddlers and Toddlers

- Provide materials
- Join infants and toddlers in exploration
- Connect experiences to what children have done or experienced before



Science Skills for Infants and Toddlers

- Observing and Describing
- Comparing and Sorting
- Questions and Predictions



Observing and Describing

Using the senses: Inviting children to use their senses and describe their observations

- *How do they feel?*
- *What do they look like?*
- *How do they smell?*
- *How do they taste?*
- *How does it sound?*



Questions you can ask to help children compare and sort:

- *Do you want the big one or the small one?*
- *This is very small, like your finger.*
- *Let's make a group for you and a group for me*
- *Can we put all the blocks together here? Then we can put the balls together here.*



Questions and Predictions

- Invite children to pose questions and model questioning for them

“Which plant is taller?”

“What will happen when we put the color tablet in the water?”

“How can we make this ball roll faster?”





VIDEO: Toddler Observing Fish Tank

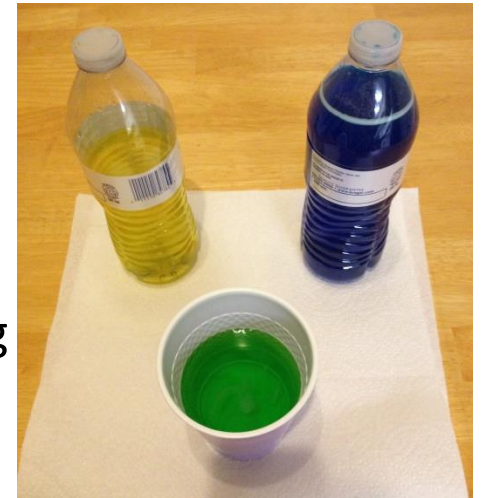
Remember and use the Scientific Method!



- Purpose: *What question are we trying to answer or discover?*
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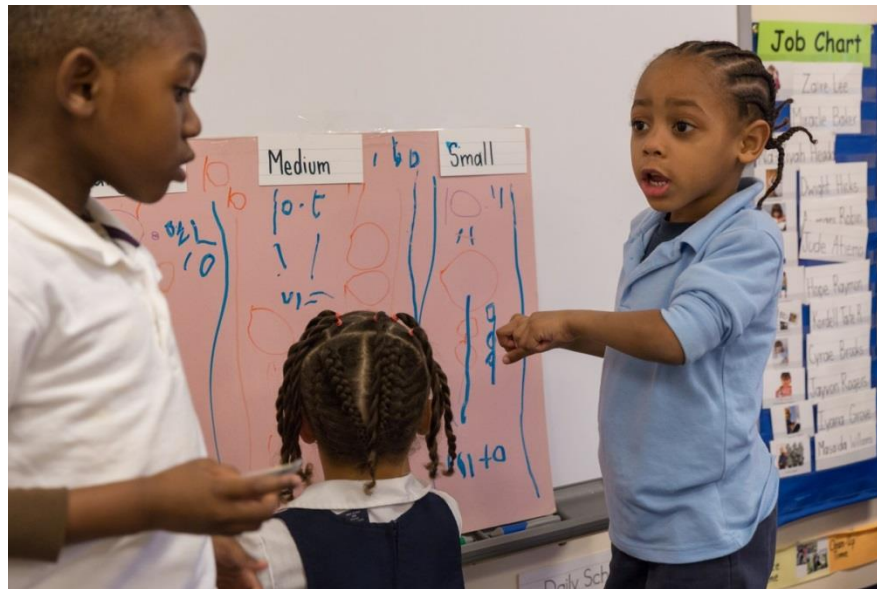
Try It Out: Color Mixing

- **In pairs, roll play:** one teacher and one toddler/baby
 - **Purpose**
 - **Hypothesis**
- **Materials:** send one person to collect 2 water bottles, 1 bowl, and 1 bag of color changing tablets
 - **Procedure**
- **Conclusion:** Come back together to discuss in 5 minutes



Early Mathematics

- Math is sequencing (1, 2, 3, 4...), patterning (1, 2, 1, 2, 1, 2...), and exploring shapes (triangle, square, circle), volume (holds more or less), and size (bigger, less than).



Early Math Skills = Later Math AND Literacy Skills



What are the Big Ideas in Mathematics?

- Number and Operations
- Geometry and Spatial Sense
- Measurement and Comparison



How do young children learn math?

- Mathematical ideas are in children's play and everyday experiences.
- Young children develop some math concepts through self-guided discoveries.
- Adult support is essential to move mathematical development along.

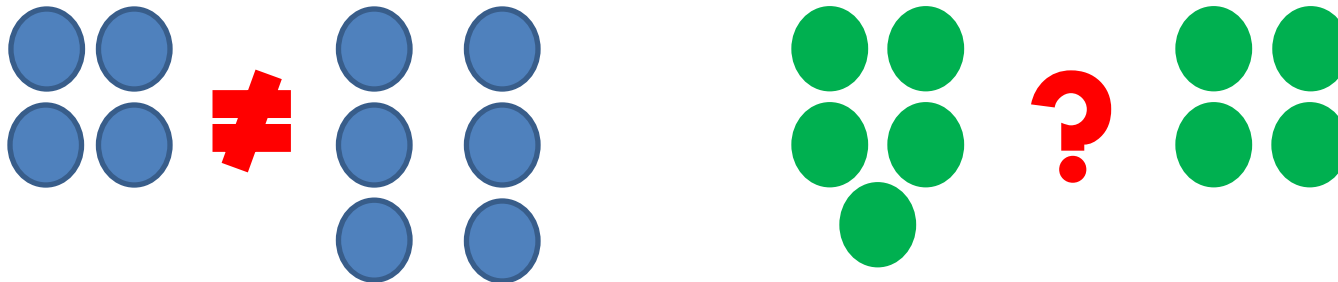


Foundations for early Number understanding for Infants

- *Young infants can see differences in small groups*



- *As they grow infants can also tell the difference in larger sets, but only if differences are clear*



Early Number understanding for Toddlers

- Toddlers can typically do tasks in home and natural environments before they demonstrate them in laboratory settings (Mix, 2002)



- Toddlers move from approximate numerosity matching to more exact ability to match small number sets.

What are Infants and Toddlers learning about Geometry and Spatial Sense?

- Manipulate objects to find out about their properties or attributes
 - How does it feel?
 - What can it do?
 - What can I do with it?
- Use their whole bodies to explore and learn
 - Crawl and walk around their environment
 - Hold and carry toys and other objects



Infants and Toddlers:

- Relate objects in play, for example...
 - Putting smaller objects inside larger objects or stacking two blocks that are the same size
 - Put their hand together or in their mouth
 - Put toys or objects on, in, or next to other objects



Help Children Learn Math through “MATHEMATIZING”


- Emphasize math ideas
- Use mathematical language
- Make comments, ask and answer questions, and pose math-related problems
- Provide a variety of materials and tools for exploration of math ideas



How to support early mathematics: MATHEMATIZE

Definition: to bring out the math in what children are doing (commenting, questioning)

- Example:



Whee! Look how fast the ball rolls down the slide.

You stayed up and the ball went down!

Which slides faster – a ball or a boy? Why does the ball go so fast?

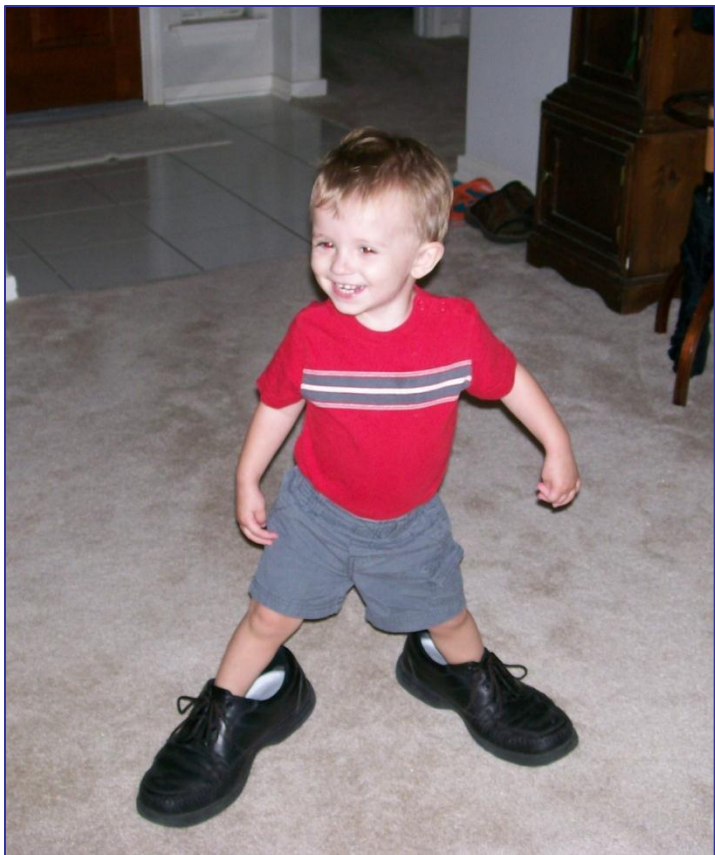
Math Connections

- ④ Shape (geometry)
- ④ Spatial concepts: up, down
- ④ Speed, comparing (measurement)

Video: Mathematize with Toddlers

- Notice the spatial words this teacher uses: up, down, around... what others do you hear?
- What other spatial words or math words would you say?

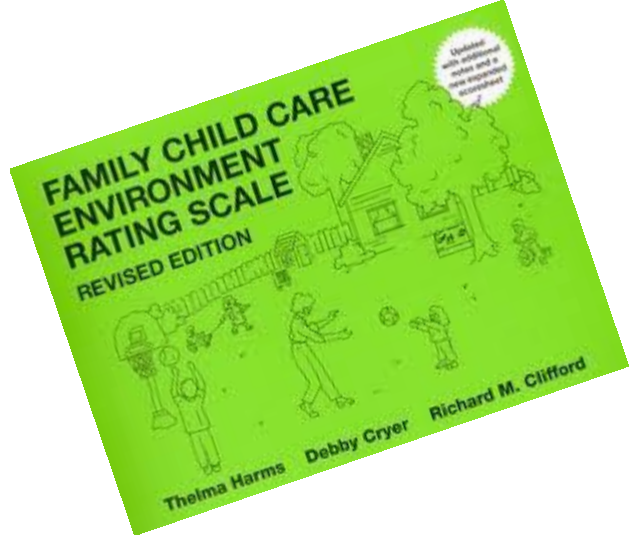
Mathematize Example: Now you try!



What are some mathematizing phrases you could say?



What Math Connections are there?



ERS TIP!



Try it out: Stacking Cups



- **In pairs, roll play:** one teacher and one toddler/baby
- **Try It:**
 - Stacking
 - Counting:
 - “Look we have stacked 1, 2, 3 cups”
 - Count as your stacking
 - Preposition words:
 - Inside, Above, Under, Behind, In, Out, Near, Far
- **Share Findings in 5 minutes**

Engineering and Technology



What is Technology?

- ***“Technology developed through engineering include the systems that provide our house with water... bridges, tunnels...cellular phones; television and computers...”***
- ***Technologies are the tools created by people through engineering to solve problems. We use technology to help us do certain tasks. Every one uses technology!***

GUIDING PRINCIPLES



“I give an expression of care every day to each child, to help him realize that he is unique. I end each program by saying, 'You've made this day a special day by just your being you. There's no person in the whole world like you. And I like you just the way you are.' And I feel that if we in public television can only make it clear that feelings are mentionable and manageable, we will have done a great service.”

Fred Rogers' Senate Testimony (1967)

NAEYC / FRED ROGERS CENTER DRAFT POSITION STATEMENT (2011)

“It is the position of NAEYC and the Fred Rogers Center that technology and interactive media are learning tools that, when used in intentional and developmentally appropriate ways and in conjunction with other traditional tools and materials, can support the development and learning of young children.”

ERS Tip!

- FCCERS-R “25. Use of TV, video, and/or computer
- Children under 24 months should not be allowed to view television/computer. In addition, media screen time is limited for children 2 years and older to not more than 30 minutes total, once a week. Computer use time should be limited to no more than 15 minutes per day with the exception of school-aged children completing homework assignments, or children with disabilities who require assistive computer technology. No media screen time should be allowed during meals/snacks.”
- ITERS-R “In addition, media screen time is limited for children 2 years and older to not more than 30 minutes total, once a week, with only 15 minutes at a time per day for computer use.”

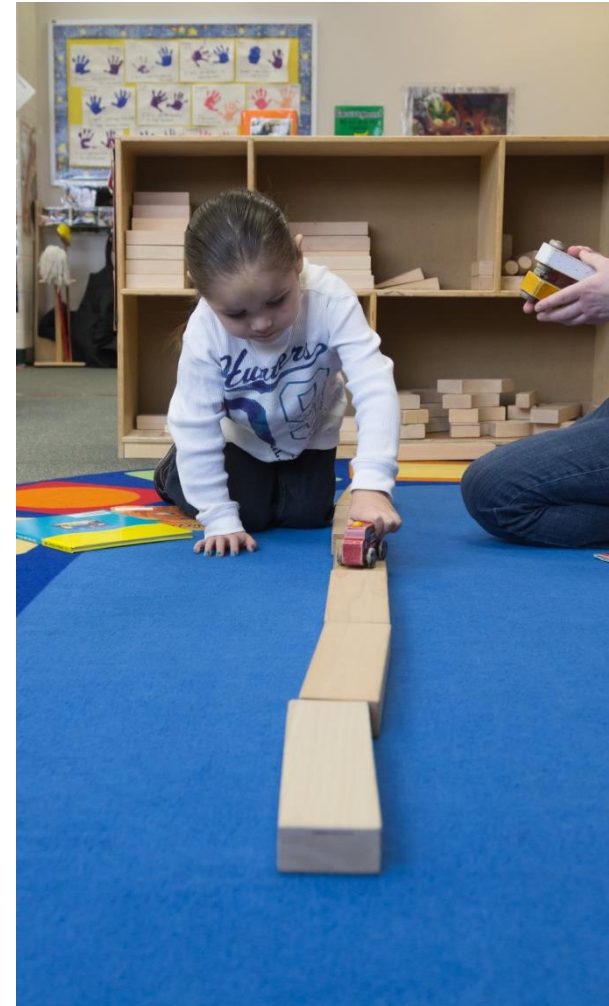
What is Engineering?

- Engineers want to know how and why things work
- Engineering is solving problems, using a variety of materials, designing and creating, and building things that work.



Engineering and Development

- Engineering – “building things that work” (Boston Children’s Museum)
- Block building improves children’s spatial skills (Casey et al., 2008)
 - Using stories with block building improves children’s block building skills



How can young children engage in engineering and technology?

- Block Building
- “Simple Machines”:
Ramps



Block Play Development

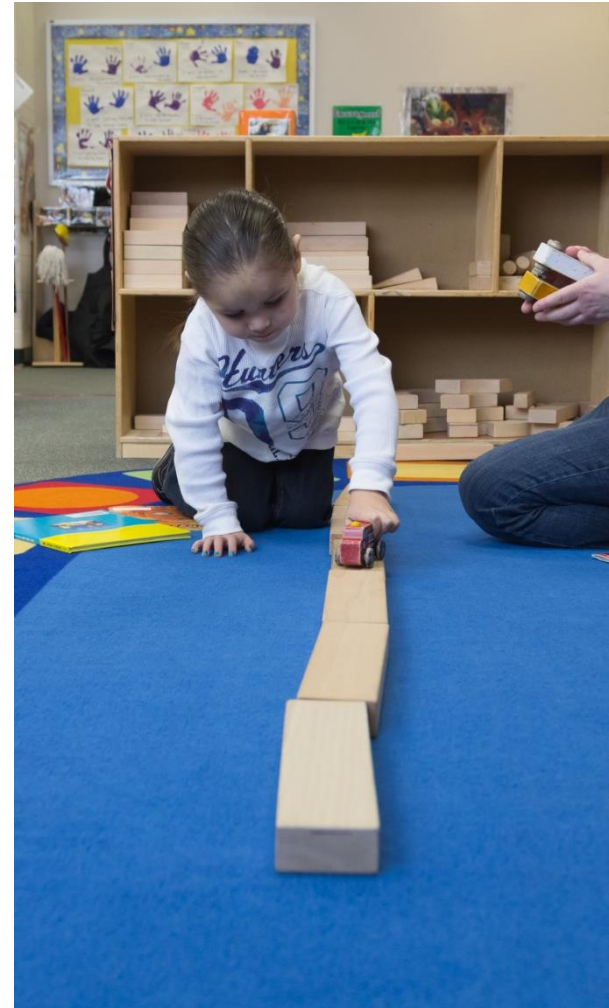
(in Casey et al., 2008)

- In the first stage of block play, children may play with one block, and use it to represent an object, such as a dog or car, in their play.
- Next, children begin to combine blocks in a one-dimensional way, by stacking them on each other (and knocking them down!)



Block Play Development continued

- Following this, children might combine blocks in a one-dimensional horizontal construction, often looking much like a “train”
- Next, children begin building two-dimensional structures such as walls or floors (typically at about two or three years of age)



Block Play Development continued

- Children may then create 3-dimensional structures, such as “piles” of blocks that do not have an “inside” (they have no interior space, it is a solid pile of blocks)
- More complex structures follow – including bridges and walls that enclose a space (there is empty space inside the structure). Children typically reach this stage between four and seven years old.



Blocks & The Environmental Rating Scale: ITERS

To reach a level 7 you need a block area that includes:

- 3 different sets of blocks AND each set of blocks needs at least 10 blocks or more
 - A variety of accessories including: transportation, people, and animals AND at least 5 of each accessory items
- Sample Kit Idea

Remember there are many other things that need to be happening to get to a level 7 in ITERS besides having materials in the classroom. Please refer to ITERS for more information.



Video: Toddler and Teacher play with connecting blocks

- What words does this teacher use?
- What type(s) of structure does this toddler make?
- Note: the connecting blocks in this video are considered “Fine Motor” materials in the ERS, however, focus on the language and interactions with these materials



VIDEO: Toddler and Teacher Playing with Blocks

Simple Machines: Ramps

- What infants and Toddlers can learn
 - Natural world
 - Experimenting
 - Observation

Now you Try!

Engineering with Ramps



How many comments can you make to help infants/toddlers think about rolling, up, down, and other STEM ideas?

How many things can you do to make this engaging and interesting for Infants and toddlers? (i.e. adding materials, smiling and clapping, etc.)

Try it out: Ramps & Balls



- **In pairs, roll play:** one teacher and one toddler/baby
- **Purpose** - **Hypothesis**
- **Materials:** send one person to exchanged your stacking cups for:
 - 1 plastic ball, 1 soft ball, 1 piece of cardboard
- **TRY IT OUT:** (switch balls with a group)
- **Conclusion:** Come back together to discuss in 5 minutes
- **Brainstorm:** How many comments can you use while exploring Ramps & Balls?

Example Kits & Mini Color Kit

Examples of how to incorporate STEM materials into your classroom



- Color Kit
- Animal Kit
- Block Kit

Before you leave don't forget your own Mini-Color Kit; including activity cards for all of the activities we did today and a few surprises materials

How Adults support STEM for Infants and Toddlers

- Plan to provide appropriate materials for exploration.
- Share in the child's curiosity!
- Help the child make sense of the experience in an age-appropriate manner by connecting new information to what they already know.



Planning for STEM through out the Day

- STEM Matrix
- Brainstorm with a partner how to bring STEM into daily routines
- Walk around, explore materials for new ideas

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**Thank
you!**

